

Claims

[c1]

What is claimed is:

1A sleeve for the receiver section for an acoustic logging tool including a tool body with receiver stations; the sleeve being capable of surrounding the tool body at least in the region of the receiver stations and having alternating first and second apertured portions spaced along its length, the first apertured portion having elongate axial bar elements separated by windows in a circumferential arrangement, the windows being wider than the bars, and the second apertured portion having rows of circumferentially elongate slots; characterised in that each slot has a centre portion and end portions, the centre portion being narrower than the end portions, and the end portions being enlarged compared to the centre portion.

[c2]

2A sleeve as claimed in claim 1, wherein the slots of the second apertured portion have parallel sides in the centre portion and approximately circular end portions.

[c3]

3A sleeve as claimed in claim 2, wherein the ratio of the width of the slot in the centre portion to the radius of the end portion is at least 1:4.

[c4]

4A sleeve as claimed in claim 3, wherein the ratio is about 1:6.

[c5]

5A sleeve as claimed in claim 1, 2 or 3 wherein each second apertured portion has three rows of slots.

[c6]

6A sleeve as claimed in any of claims 1 to 5, wherein each first apertured portion has eight windows.

[c7]

7A sleeve as claimed in any of claims 1 to 6, wherein the first apertured portion has windows of two alternating widths.

[c8]

8A sleeve as claimed in claim 7, wherein the windows have widths of 25° and 45° respectively.

[c9]

9A sleeve as claimed in any of claims 1 to 8, when forming part of an acoustic logging tool having a tool body with a transmitter section and a receiver

section.

[c10]

10A acoustic logging tool comprising a tool body with a transmitter section and a receiver section comprising a number of receiver stations spaced along a tool body, each station including a number of polarised pressure sensors spaced around the circumference of the tool body, and a sleeve surrounding the tool body at least in the region of the receiver stations and having alternating first and second apertured portions spaced along its length, the first apertured portion having elongate axial bar elements separated by windows in a circumferential arrangement, the windows being wider than the bars, and the second apertured portion having rows of circumferentially elongate slots, characterised in that the sleeve comprises a sleeve as claimed in any of claims 1 to 9 and the axis of polarisation of the sensors is parallel to the axis of the tool body.

[c11]

11A tool as claimed in claim 10, wherein the pressure sensors comprise piezoelectric stacks.

[c12]

12A tool as claimed in claim 10 or 11, wherein each station has four pressure sensors spaced equidistantly around the tool body.

[c13]

13A tool as claimed in claim 10, 11 or 12, comprising a central mandrel around which are mounted alternate, pressure sensor mounts and spacers, the spacers being firmly connected to the mandrel and the sensor mounts being held in position by the spacers.

[c14]

14A tool as claimed in claim 13 wherein the spacers and pressure sensor mounts are made of steel.

[c15]

15A tool as claimed in claim 13 or 14, wherein each pressure sensor mount contacts its neighbouring spacers via resilient contact pads.

[c16]

16A tool as claimed in any of claims 13, 14 or 15, wherein, when arranged vertically, the weight of each pressure sensor mount is carried by the spacer located below that mount.

[c17]

17A receiver section for an acoustic logging tool comprising a number of

receiver stations spaced along a tool body, each station including a number of polarised pressure sensors spaced around the circumference of the tool body, characterised in that the axis of polarisation of the sensors is parallel to the axis of the tool body.

- [c18] 18A receiver section as claimed in claim 17, wherein the pressure sensors comprise piezoelectric stacks.
- [c19] 19A receiver section as claimed in claim 17 or 18, wherein each station has four pressure sensors spaced equidistantly around the tool body.
- [c20] 20A receiver section as claimed in claim 17, 18 or 19, comprising a central mandrel around which are mounted alternate, pressure sensor mounts and spacers, the spacers being firmly connected to the mandrel and the sensor mounts being held in position by the spacers.
- [c21] 21A receiver section as claimed in claim 20 wherein the spacers and pressure sensor mounts are made of steel.
- [c22] 22A receiver section as claimed in claim 20 or 21, wherein each pressure sensor mount contacts its neighbouring spacers via resilient contact pads.
- [c23] 23A receiver section as claimed in claim 20, 21 or 22, wherein, when arranged vertically, the weight of each pressure sensor mount is carried by the spacer located below that mount.
- [c24] 24A receiver section as claimed in any of claims 17 to 23, when forming part of an acoustic logging tool having a sonde body which also includes a transmitter section.

[c25]

25A receiver section as claimed in any of claims 17 to 24, further comprising a sleeve being capable of surrounding the tool body at least in the region of the receiver stations and having alternating first and second apertured portions spaced along its length, wherein

(a) the first apertured portion has elongate axial bar elements separated by windows in a circumferential arrangement, the windows being wider than the bars, and

(b) the second apertured portion has rows of circumferentially elongate slots, each slot having a centre portion and end portions, the centre portion being narrower than the end portions, and the end portions being enlarged compared to the centre portion.

- [c26] 26A receiver section as claimed in claim 25, wherein the slots of the second apertured portion have parallel sides in the centre portion and approximately circular end portions.
- [c27] 27A receiver section as claimed in claim 26, wherein the ratio of the width of the slot in the centre portion to the radius of the end portion is at least 1:4.
- [c28] 28A receiver section as claimed in claim 27, wherein the ratio is about 1:6.
- [c29] 29A receiver section as claimed in claim 25, 26 or 27 wherein each second apertured portion has three rows of slots.
- [c30] 30A receiver section as claimed in any of claims 25 to 29, wherein each first apertured portion has eight windows.
- [c31] 31A receiver section as claimed in any of claims 25 to 30, wherein the first apertured portion has windows of two alternating widths.
- [c32] 32A receiver section as claimed in claim 31, wherein the windows have widths of 25° and 45° respectively.
- [c33] 33 A sleeve for the receiver section for an acoustic logging tool, wherein said tool comprises a tool body with receiver stations, said sleeve being capable of surrounding the tool body in at least the region of the receiver stations and having alternating first and second apertured portions spaced along its length; the first apertured portion having elongate axial bar elements separated by windows in a circumferential arrangement, the windows being wider than the bars; and the second apertured portion having rows of circumferentially elongate slots, characterized in that each slot has a center portion and end portions, the center portion being narrower than the end portions and the end portions being enlarged compared to the center portion.

- [c34] 34.The sleeve of claim 33, wherein the slots of the second apertured portion have parallel sides in the center portion and approximately circular end portions.
- [c35] 35. The sleeve of claim 34, wherein the ratio of the width of the slot in the center portion to the radius of an end portion is at least 1:4.
- [c36] 36.The sleeve of claim 35, wherein the ratio is about 1:6.
- [c37] 37.The sleeve of claim 33, wherein each second apertured portion has three rows of slots.
- [c38] 38.The sleeve of claim 33, wherein each first apertured portion has eight windows.
- [c39] 39.The sleeve of claim 33, wherein the first apertured portion has windows of two alternating widths.
- [c40] 40.The sleeve of claim 39, wherein the windows have widths of 25 ° and 45 ° respectively.
- [c41] 41.The sleeve of claim 33, wherein said sleeve forms a part of an acoustic logging tool comprising a tool body with a transmitter section and a receiver section.
- [c42] 42.A sleeve for a receiver section for an acoustic logging tool comprising a tool body with receiver stations; said sleeve being capable of surrounding the tool body at least in the region of the receiver stations and having alternating first and second apertured portions spaced along its length; the first apertured portion having elongate axial bar elements separated by a plurality of windows of alternating widths, wherein said windows have widths ranging from 25 ° to 45 ° ; and wherein each second apertured portion has a plurality of rows of slots, wherein said slots have parallel sides in the center portion and approximately circular end portions.
- [c43] 43.An acoustic logging tool comprising a tool body with a transmitter section and a receiver section, said receiver station comprising a number of receiver

stations spaced along a tool body, each station including a number of polarized pressure sensors spaced along the circumference of the tool body, wherein the axis of polarization of the sensors is parallel to the axis of the tool body; and a sleeve surrounding the tool body at least in the region of the receiver stations and having alternating first and second apertured portions spaced along its length, the first apertured portion having elongate axial bar elements separated by windows in a circumferential arrangement, the windows being wider than the bars; and the second apertured portion having rows of circumferentially elongate slots, wherein each slot has a center portion and end portions.

[c44] 44. The tool of claim 43, wherein said center portion of said slots is narrower than said end portions and said end portions is enlarged compared to the center portion.

[c45] 45. The tool of claim 43, wherein said pressure sensors comprise piezoelectric stacks.

[c46] 46. The tool of claim 43, wherein each station has four pressure sensors spaced equidistantly around the tool body.

[c47] 47. The tool of claim 43, further comprising a central mandrel around which are mounted alternate, pressure sensor mounts and spacers, the spacers being firmly connected to the mandrel and the sensor mounts being held in position by the spacers.

[c48] 48. The tool of claim 47, wherein said spacers and said pressure sensor mounts are made of steel.

[c49] 49. The tool of claim 47, wherein each said pressure sensor mount contacts its neighboring spacers via resilient contact pads.

[c50] 50. The tool of claim 47, wherein, when arranged vertically, the weight of each pressure sensor mount is carried by the spacer located below that mount.

[c51]

51. An acoustic logging tool comprising a tool body with a transmitter section and a receiver section, said receiver section comprising a number of receiver stations spaced along a tool body, each station including a number of polarized

pressure sensors spaced around the circumference of the tool body, wherein said pressure sensors comprise piezoelectric stacks and each station comprises a plurality of pressure sensors spaced around the tool body.

[c52] 52. A receiver section for an acoustic logging tool comprising a number of receiver stations spaced along a tool body, each station including a number of polarized pressure sensors spaced around the circumference of the tool body, characterized in that the axis of polarization of the sensors is parallel to the axis of the tool body.

[c53] 53. The receiver section of claim 52, wherein the pressure sensors comprise piezoelectric stacks.

[c54] 54. The receiver section of claim 52, wherein each said station comprises four pressure sensors spaced equidistantly around the tool body.

[c55] 55. The receiver section of claim 52, further comprising a central mandrel around which are mounted alternate, pressure sensor mounts and spacers, the spacers being firmly connected to the mandrel and the sensor mounts being held in position by the spacers.

[c56] 56. The receiver section of claim 55 wherein the spacers and pressure mounts are made of steel.

[c57] 57. The receiver section of claim 55 wherein each pressure sensor mount contacts its neighboring spacers via resilient contact pads.

[c58] 58. The receiver section of claim 55, wherein, when arranged vertically, the weight of each pressure sensor mount is carried by the spacer located below that mount.

[c59] 59. The receiver section of claim 52, wherein said receiver section forms a part of an acoustic logging tool comprising a sonde body and a transmitter section.

[c60] 60. A receiver section for an acoustic logging tool comprising a number of receiver stations spaced along a tool body, each station including a number of polarized pressure sensors spaced around the circumference of the tool body,

characterized in that the axis of polarization of the sensors is parallel to the axis of the tool body, wherein said section further comprises a sleeve capable of surrounding the tool body at least in the region of the receiver stations and having an alternating first and second apertured portions spaced along its length, wherein

(a) the first apertured portion has elongate axial bar elements separated by windows in a circumferential arrangement, the windows being wider than the bars, and

(b) the second apertured portion has rows of circumferentially elongate slots, each slot having a center portion and end portions, the center portion being narrower than the end portions, and the end portions being enlarged compared to the center portion.

[c61] 61.The receiver section of claim 60, wherein the slots of the second apertured portion have parallel sides in the center portion and approximately circular end portions.

[c62] 62.The receiver section of claim 61, wherein the ratio of the width of the slot in the center portion to the radius of the end portion is at least 1:4.

[c63] 63.The receiver section of claim 62, wherein the ratio is about 1:6.

[c64] 64.The receiver section of claim 60 wherein each second apertured portion has three rows of slots.

[c65] 65.The receiver section of claim 60 wherein the first apertured portion has windows of two alternating widths.

[c66] 66.The receiver section of claim 64, wherein the windows have widths of 25 ° and 45 ° respectively.

~~[c67]~~

67.A receiver section for an acoustic logging tool comprising a number of receiver stations spaced along a tool body, each station including a number of polarized pressure sensors spaced around the circumference of the tool body, characterized in that the axis of polarization of the sensors is parallel to the axis of the tool body, wherein said section further comprises a sleeve capable of

surrounding the tool body at least in the region of the receiver stations and having an alternating first and second apertured portions spaced along its length, wherein

- (a) the first apertured portion has elongate axial bar elements separated by windows in a circumferential arrangement, the windows being wider than the bars, wherein said windows are of a plurality of alternating widths, and
- (b) the second apertured portion has a plurality of rows of circumferentially elongate slots, each slot having a center portion and end portions, the center portion being narrower than the end portions, and the end portions being enlarged compared to the center portion, wherein the ratio of the width of the slot in the center portion to the radius of the end portion is at least 1:4.

Added Q17